

Compatibility of Mating Preferences

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Human mating is a complex phenomenon. Although men and women have different preferences in mate selection, there should be compatibility in these preferences since human mating requires agreement of both parties. We investigate how compatible the mating preferences of men and women are in a given property such as age, height, education and income. We use dataset of a large online dating site ($N = 44,255$ users). (i) Our findings are based on the “actual behavior” of users trying to find a date online, rather than questions about a “hypothetical” partner as in surveys. (ii) We confirm that women and men have different mating preferences. Women prefer taller and older men with better education and higher income than themselves. Men prefer just the opposite. (iii) Our findings indicate that these differences complement each other. (iv) Highest compatibility is observed in income with 95 %. This might be an indication that income is in the process of becoming more important than other properties, including age, in our modern society. (v) An evolutionary model is developed which produces similar results.

Keywords: mating, mate selection, mating preferences, parental investment, gender compatibility, evolution, online dating

INTRODUCTION

Mating and Parental Investment

Mating is important for evolution. In many species, it has been observed that males and females have different strategies in mate selection. An evolutionary theory to explain differences in mating strategies is Trivers’ *parental investment theory* [1]. He carefully defines *parental investment* as “any investment by the parent in an individual offspring that increases the offspring’s chance of surviving (and hence reproductive success) at the cost of the parent’s ability to invest in other offspring” [1]. Therefore, evolution calls for parental support, since offsprings with more parental support have better chance to reproduce.

Parental investment is quite uneven between male and female in many species [1]. Therefore, both genders evolutionarily developed mating strategies, which are clearly different [2–5]. Human female makes mandatory high investment in offspring compared to male, if one considers nine months of gestation, childbirth, lactation, nurturing. Therefore, she looks for a supporting male in her mate selection. She prefers a male who not only has the resources to support her but also willing to commit these resources to her. This explains female preference for *long-term* commitment. On the other hand, human male can prioritize quantity. Relative to the female, he is reluctant to engage in long term commitment, partly due to *parental uncertainty*, that is, he cannot be hundred percent sure that the child carries his genes. He has a tendency for *short-term* relations, which increases his chances to reproduce offsprings. This quality versus quantity trade-off creates a conflict that has to be resolved. Females, who invest more in offspring, should be more choosy selecting a mate (*intersexual attraction*) and males, who invest less, should compete with other males to access the opposite sex (*intrasexual competition*) [1].

Properties in Mate Selection

Properties that increase the chance of mating become crucial in this respect [1–10]. In terms of evolution, (i) *fertility*, i.e., immediate probability of conception, and (ii) *reproductive value*, i.e., future reproductive potential, are the top two properties for both genders [4]. In many species, younger and healthier members are more likely to have these properties, which makes them more attractive as mates. Human males are particularly tuned to these properties in mate selection. However, because of the immense cost of reproducing, human females are attentive to other properties as well, namely (i) the ability to gather resources and (ii) the willingness to commit these resources to her offspring. Human societies are heavily hierarchical with those at the top typically having much more power and access to material resources. It takes time for a typical man to rise up in the hierarchy. Therefore, older men are more likely to have the properties desired by women than their younger counterparts. In addition, men that are physically stronger or otherwise advantageous (e.g., taller) will be better able to protect a dependent (pregnant or nursing) mate and her vulnerable offspring. Hence, physically masculine men should be preferred by women [9]. In sum, we expect that youth in women, and older age and masculinity in men are properties that complement each other in mate selection.

Empirical evidence supports these deductions [2, 5–11]. In couples, the man is typically older [7], and taller [8–10] than the woman. This is a universal pattern across cultures [2, 11].

Since mating requires agreement of both parties, although men and women have different preferences in mate selection, there should be compatibility in these preferences. The question that guides the present research is: How compatible are the mating preferences of

two genders regarding a given property?

METHOD

We use the data obtained from an online dating site. First, we carefully define “mating” in our data set. (See [Data Set](#) and [Definition of Mating](#) in the Appendix.) Then we aggregate the properties of partners that an individual selects as mates. Finally we search for patterns in the properties for mating behavior.

Definitions

Properties of the Mate

Once we have identified the partners, we investigate the properties of the mate. As expected, user i becomes partner with various others in time. Each partner of i may have a different value for property p . The average of the properties of the partners of i is given as

$$\bar{p}_i = \frac{1}{|C_i|} \sum_{j \in C_i} p_j$$

where C_i is the set of users that i partnered with, and p_j denotes the property p as it is defined in user j ’s profile. We interpret this as follows: User i has a tendency to select partners having value of \bar{p}_i in property p . Hence, we call \bar{p}_i as the *preferred value* for i .

Preferred Difference

Instead of using the preferred value directly, we compare one’s own value to the preferred value that one looks for in his partners. The *preferred difference* of i , in property p , is defined as

$$\Delta p_i = \bar{p}_i - p_i.$$

Note that Δp_i can be positive or negative. If Δp_i is around 0 then the user prefers partners with similar properties with her, i.e. homophily [12, 13]. If user i has a tendency to select partners that are taller than herself, then Δp_i in height would be positive; otherwise it would be negative.

Preferred Difference Distributions

We can extend these concepts from individual i to a group of people. Then, frequency of people with the same preferred difference makes a probability distribution, which we call *preferred difference distribution*. Having all women as one group, and all men as another group,

we obtain two preferred difference distributions $f(x)$ and $m(x)$ of females and males, respectively.

RESULTS

We investigate four properties, namely, age, height, income and education. As already discussed in the [Introduction](#) section, age and masculinity are important properties in mating for all species. Height is considered as an indication of masculinity. The other two properties, income and education, are unique to humans.

The statistical parameters of the preferred difference distributions in age, height, education, and income are given in Table I. Columns μ_m , μ_f , and σ_m , σ_f are the averages and standard deviations of men and women, respectively. We first focus on the averages, and leave the discussion of the distributions of the preferred differences, and their compatibility ρ for later.

Averages of Preferred Differences

In all four properties in Table I, there is a distinct pattern: The averaged preferred differences for men, μ_m , are all negative and those of women are all positive. This observation indicates that in all four properties, regardless of the metric that is used to measure the property, men prefer women with lower scores and women prefer men with higher scores, compared to themselves.

Height

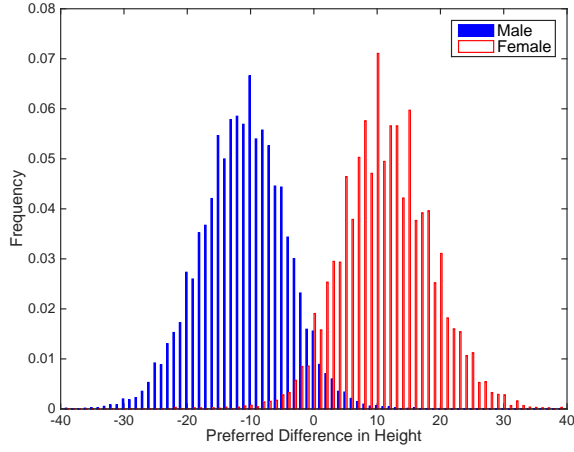
Our findings on preferred difference in height, given in Fig. 1a, do not agree with the similarity hypothesis in mate selection. Only a minority of men and women are accumulated around the zero point, which is the point of no preferred difference (i.e., maximum similarity). Instead, the averages in Table I agree with the male-taller norm. On average, men prefer women 11.12 cm shorter. Similarly, on average women prefer men 11.37 cm taller. The distributions in Fig. 1a clearly show that the majority of men prefer shorter women and, in complementary fashion, the majority of women prefer taller men. Thus, online daters are attracted to others who complement their height preferences. These findings replicate previous work on the male-taller norm [8?].

Age

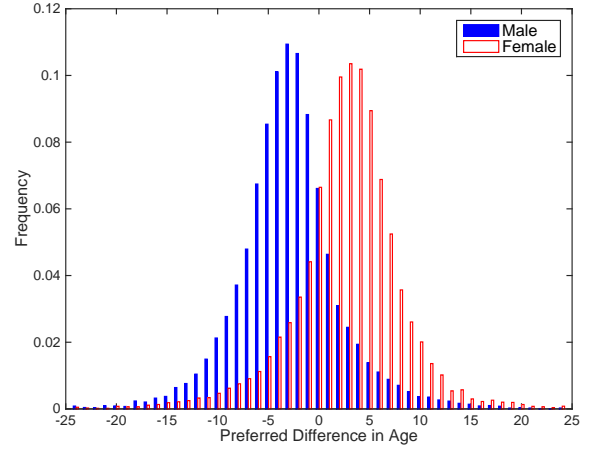
According to evolutionary theories, we expect to see a greater prevalence of younger woman-older man partners than alternative age couplings. Our findings reveal such a pattern in mate preferences in online daters.

TABLE I: Comparison of male and woman distributions

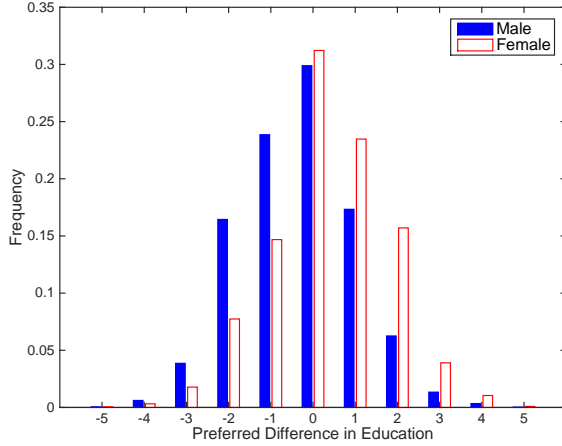
Property	Averages		Standard Deviations		Compatibility
	μ_m	μ_f	σ_m	σ_f	
Income (bin)	-0.93	0.99	1.28	1.32	0.95
Age (year)	-2.90	2.74	5.06	5.23	0.94
Education (bin)	-0.36	0.34	1.35	1.40	0.92
Height (cm)	-11.12	11.37	6.76	7.09	0.90



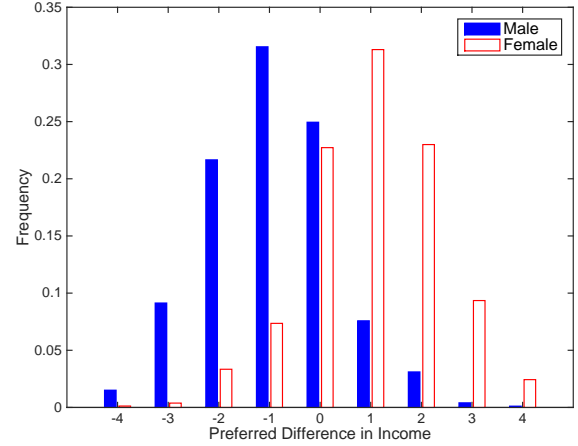
(a) Height



(b) Age



(c) Education



(d) Income

FIG. 1: (Color online) Preferred difference distributions.

Examination of age preference distributions, given in Fig. 1b, indicates that the majority of men prefer younger women whereas the majority of women prefer older men. On average, men mate with women 2.90 years younger than themselves, and women mate with men 2.74 years older than themselves. Our findings are in agreement with Buss [2], which reports that men prefer 2.66 years younger, women prefer 3.42 years older mate than them-

selves.

Income and Education

We observe similar patterns in income and education, as well. Namely, men prefer negative and women prefer positive differences. Here the numbers cannot be com-

pared with other works directly since users are asked to select one bin out of many bins, which are organized in a consistent but arbitrary way [14]. They are consistent in the sense that the larger the bin number, the more educated or higher income. The bins in education are arranged according to the years spent in school such as graduate of primary school, or of college. The bins in the income field represent monthly income such as bin-2: $500 < x < 1,000$, bin-3: $1,000 < x < 2,000$.

Distribution of Preferred Differences

Note that the absolute values of the average preferred difference of men and women, as well as the standard deviations of preferred differences, are close to each other in Table I. We aimed to examine whether this was coincidental or substantive.

For this purpose, we relied on the distributions of preferred differences in height, age, education, and income that are given in Fig. 1. The bell-shaped curves of male and female distributions resemble to each other. Female curves are right-shifted while male curves are left-shifted, with respect to the y -axis.

How do we compare these curves? In order to get a better understanding, consider a simplified example given in Fig. 2. Note that women that prefer $\Delta p = x$ match with men that prefers $\Delta p = -x$. Therefore, we should not directly compare the distribution $f(x)$ of women with $m(x)$ of men. We should compare $f(x)$ with $m(-x)$, that is, the symmetric graph with respect to the y -axis. We make the reasonable assumption that there are equal number of men and women. Then, $\min\{f(x), m(-x)\}$ of the women who prefer $\Delta p = x$ are matched. Thus, the *compatibility* of two distributions can be measured by means of the ratio of matched women given as

$$\rho = \sum_x \min\{f(x), m(-x)\}$$

where summation is taken over all possible values of x . Note that $0 \leq \rho \leq 1$ where $\rho = 1$ means women and men are perfectly compatible. This is a well-defined metric since the ratio of matched women is equal to that of men.

MODEL

The properties are listed in descending order of compatibility in Table I. Height is the property with the lowest compatibility. Even for this property, 90 % of the population can find a partner who satisfies one's preferences. What kind of dynamics can lead the system to such a high compatibility?

A simple evolutionary model can explain high compatibility values. (See [Details of the Model](#) in the Appendix.) As an abstraction, we consider agents with one

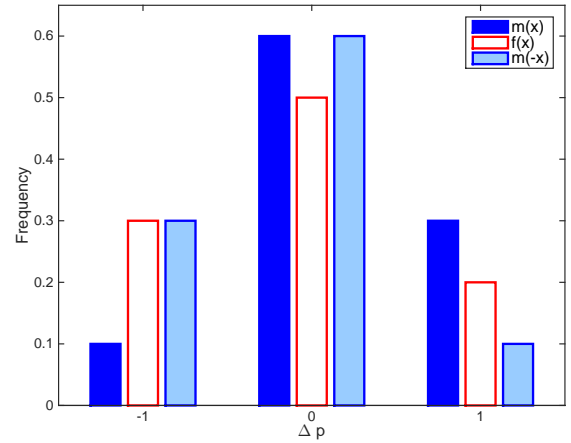


FIG. 2: (Color online) **Distribution of difference in a dummy property p .** We assume that Δp takes values of $-1, 0$, and 1 . We also assume that woman and male populations are of the same size. (i) 50 % of women and 60 % of men prefer no differences in p . Hence 50 % matches for $\Delta p = 0$. (ii) 20 % of women who prefer difference of $\Delta p = 1$ are to match with 10 % of men who prefer differences of $\Delta p = -1$. Only 10 % matches for $\Delta p = 1$. (iii) 30 % of women who prefer difference of $\Delta p = -1$ are exactly match with 30 % of men who prefer differences of $\Delta p = 1$. That is, 30 % matches for $\Delta p = 1$. In total 90 % of women are matched. Hence male female compatibility is $\rho = 0.90$.

property only, such as age. It starts with male and female population with diversified values in the property, hence low compatibility. As the system evolves, the compatibility increases as seen in Fig. 3.

The increase of compatibility is due to the decrease of genetic variation. Simulations of the model reveal that genetic variation is reduced from generation to generation. Agents, that cannot find mates, are eliminated from the system. Agents, whose genotype fits the population, survive. Hence the compatibility of the population increases. It is observed that the system converges to the perfect compatibility most of the time. Convergence is quite fast. For $N = 100$, no more than 200 generations are usually sufficient. Of course, there are some realizations that become extinct but they are rare. Interestingly, in many realizations genotype pool reduces to one female and one male genotype.

DISCUSSION AND CONCLUSIONS

Men and women behave differently [15–19]. Our findings show that the virtual world of online dating is another manifestation of gender differences.

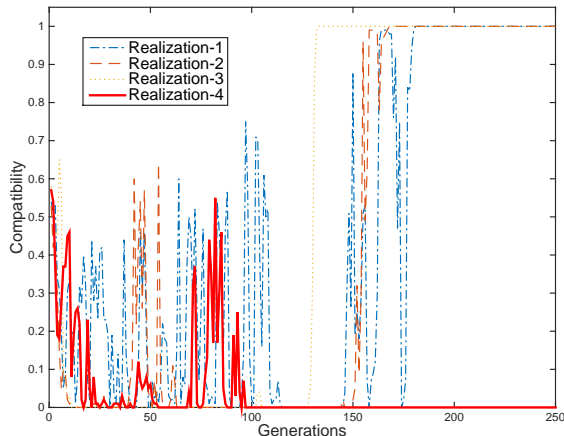


FIG. 3: (Color online) **Sample realizations of the model.** Many realizations survive and reach to the perfect compatibility of 1. Only a few become extinct.

As a representative of extinction, Realization-4 is included to the plot. ($N = 100$, $R = 9$, $M = 20,000$).

Opposite Preferences in Scores

While women prefer men with higher scores in every property that we have investigated, men show just the opposite pattern. This supports findings from previous studies but with the added benefits of (i) focusing on the actual mating behaviors of real people, and (ii) drawing on such a large sample of $N = 44,255$.

Compatibility of Preferences

Interestingly, the preferences of men and women match each other so that the number of dissatisfied seekers is minimized. This can be explained by evolution. Individuals with preferences that do not match what is available in the current population have restricted mating opportunities and, consequently, lower reproductive success. The proposed model shows that, as it evolves, a population becomes more homogeneous in terms of variation in the preferences. The genomes that fit the population are selected more and eventually dominate the population.

Ranking of Properties

The mating properties should be ranked in terms of importance. We expected that the system should tune itself to maximize compatibility first in age and then in height. Interestingly, it is observed that income is the property with the highest compatibility of 95 %.

One possible explanation might be the change in society across time. Income may have taken precedence over

other properties, such as age, in today's society. High income has great utility for solving evolutionary problems, if one considers the impact of accessing medical care for health, and also medical support for reproduction. This may be the reason why both genders in contemporary society have become especially attuned to income and consequently learned to adapt their preferences for maximum compatibility with the opposite gender.

Age may have been a much more reliable cue to a man's ability to obtain status, wealth, and resources in the ancestral environment than in today's society. However, age is still an important cue for female fertility and thus follows income as the property with the second highest compatibility level 94 %. Clearly, 1 % difference between income and age makes these suggestions highly speculative and calls for further research.

In our modern society, we may speculate that ability to protect a woman partner and the offspring physically, which may be facilitated by height, loses importance, leading to height being the property with the lowest level of compatibility in the current sample.

Education, which can be related to social position and correlated with income, gets the third place as height loses its importance.

Actual versus Hypothetical Preferences

As a final but important point, we would like to stress that our findings are not based on surveys, in which one answers questions about a "hypothetical" partner, one wishes to have, as in many other works such as ref [2]. Our findings are based on the "actual behavior" of users trying to find a date online. Our data tracks "actual" partners, that is, people who have mutually agreed to "mate" as far as one can trace in an online dating site.

In addition, as in many surveys, we do have data about "hypothetical" mate preferences, too. Users specify what properties, such as age and height, they look for in their potential partners. However, such self-reported preferences are not consistent with actual behavior. For example, someone might claim that he prefers women taller than 170 cm but show no hesitation to partner with a woman who is 160 cm. Such inconsistencies are not apparent if research focuses only on questionnaire responses. In this respect our behavioral data deserves special attention.

APPENDIX

Data Set

We investigate the data of a large online dating site for compatibility of mating preferences [14]. There are 4,500,000 registered users in total. More than 3,000 new

users register daily. Users stay in the system for three months on average. Many of those who leave come back later; sometimes as a new user. The daily activity is also quite large in volume with 50,000 user logins, 500,000 messages, and 20,000 votes (of other’s profiles).

Privacy and Data Availability

Privacy is the most important issue for such an investigation. In this study, all data gathering and data processing is done at the company site. No data left the company. Only statistical data such as the histogram data visualized in Fig. 1 is shared with us. This histogram data is available at [20].

Other Issues

One needs to be careful on a number of issues in a study like the present one. (i) The user defines his properties in the profile. Hence, user properties may be misleading. On the other hand, stretching the properties too far would not be a good strategy since unfaithful declaration, such as claiming to be slim while actually being obese, would be an obstacle to further the relationship when the time comes to meet face-to-face [21, 22]. So we assume that users are close to what they claim to be. (ii) One has to keep in mind that the findings could be culture dependent. (iii) We focus on heterosexual relations only. Wholly other dynamics might be in motion in non-heterosexual relationships.

Definition of Mating

A typical online dating system enables its user to find a partner that best matches one’s preferences. Each user defines his or her user profile. An initiator, predominantly man, selects a potential partner by examining her profile and sends her a message. If there is a positive response from the receiver, then more messages are exchanged which may eventually lead to a face-to-face meeting.

When do we say that a man and a woman are mating? Online dating sites contain abundant information in the virtual domain (i.e., profiles), but there is usually no information whether the man and the woman are actually mating in the physical world. Any action in an online dating site is clearly an attempt for mating but is this sufficient to be considered mating? For example, just sending a message, getting a message in response, or even exchanging a series of messages should not qualify as mating since the nature of just seeking a partner online already involves these activities.

Virtual Gifts

Therefore we select the most restricted criteria of mutual interest that is available in our data set, which is based on virtual gifts [14]. Receiving a *virtual gift*, which is usually a picture of a flower, is considered a “value” in this virtual society. We have even observed that some users sent virtual gifts to themselves. This value is probably due to a number of reasons: (i) The virtual gifts one receives is visible to all. (ii) They are not free, i.e., one has to purchase virtual gifts with actual money. (iii) Only qualified users can send virtual gifts. Since unpaid male members are not qualified to send gifts, being able to send gifts may be considered an indication of wealth.

Considering virtual gifts drastically reduces the subject size. Within 4,500,000 registered users; there are 276,210 men and 483,963 women that are qualified to send virtual gifts in the system. Among those, only 29,274 men and 14,981 women, in total $N = 44,253$, users reciprocally exchange virtual gifts. Hence we define a pair as (*mating*) *partners* if they have exchanged (i.e., send and receive) at least one gift.

Details of the Model

Agents

Agent i represented by a 4-tuple $(g_i, p_i, p_i^{\min}, p_i^{\max})$, called *genotype*, where *gender* g_i is a binary number with 0 being female. The property takes values in the *value range* of $\{1, 2, \dots, R\}$ for some positive integer R . The *property* of the agent is denoted by p_i . The values p_i^{\min} and p_i^{\max} represent a range for possible mate. That is, the agent “agrees” to mate with an agent with p_j only if $p_i^{\min} \leq p_j \leq p_i^{\max}$. We will get back to mating shortly.

Generations

We have to initialize the very first generation. The rest of the generations are driven by the system. The first generation is composed of N female and N male agents. We initialize female and male agents differently. In order to initialize an agent, we draw three numbers from a uniform random distribution in the value range and order them so that we have $p_1 \leq p_2 \leq p_3$. Then if the agent is female, set its genotype to $(0, p_1, p_2, p_3)$, otherwise to $(1, p_3, p_1, p_2)$. Note that we use the minimum of the numbers for her score since females prefer males that have higher scores than theirs. Similarly, males prefer females with lower scores. That is, our model starts with agents that are agree with the “female prefers higher scores, male prefers lower scores” assumption.

Life span of a generation is defined as M meetings in total. After M meetings, the parents are removed and

the children become the next generation. Note that the number of girls and the boys are usually different than N . If the population of any gender exceeds N , we randomly eliminate some so that every generation has no more than N females and N males. If the population of a gender is less than N , we do not do anything to increase it to N . Of course, if the population of one gender becomes zero, then the system stops reproducing.

Mating and Reproduction

We let agents obtain the chance to reproduce by randomly picking a female and a male to *meet*. A meeting produces a child if both agents “agree” to mate. Agreement is defined as follows. Agent i *agrees* to mate with the opposite gender agent j if j is in the mating range of i , that is, $p_i^{\min} \leq p_j \leq p_i^{\max}$. For example, male (1, 5, 2, 5) accepts female (0, 2, 6, 8) but the female does not accept the male.

The child is set to be female with probability 0.5. We used a very simple inheritance mechanism: the daughter gets the properties of the mother and the son gets that of the father. Therefore, the genotype of either the mother or the father is preserved in the next generation. Since a child gets exactly the same genotype of either parent, and since agents in our initial generation agree with the “female prefers higher scores, male prefers lower scores” rule, this rule is preserved in all generations.

Genotype Variety

We obtain the first generation by repeating agent initiation process N times for female and N times for male. Hence we expect that the initial generation has quite a variety of genotypes, possibly $2N$ different genotypes. Since there is neither mutation nor recombination of genotypes, there is no way that the genotype variety of the system can increase. On the contrary, it can reduce when the last member of a genotype fails to reproduce.

Note that we do not consider mutations in this very simple model. One may extend the model by introducing mutations.

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